

Infrared Tutorial

-- Discovery --

In 1800, Sir William Herschel, the royal astronomer to the King of England, conducted an experiment to study the heating effects of sunlight. He used a prism to separate light into the colors of the spectrum and used a thermometer to measure the temperature in each color. As he moved from the violet to the red region, the temperature increased; however, when he placed the thermometer in the region just beyond the color red, the temperature continued to increase, even when no light was visible to the naked eye. William Herschel had just discovered the portion of the electromagnetic spectrum known as “infrared.”

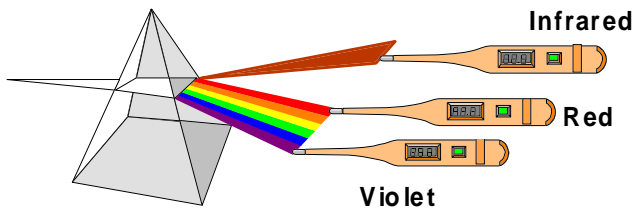


Fig. 1: Herschel used a prism and thermometers in his experiment that eventually led to the discovery of the infrared region of the electromagnetic spectrum.

-- Properties --

All objects emit infrared radiation. The temperature of an object determines how much radiation is emitted and at what particular wavelength. The higher a body's temperature, the more radiation emitted and the shorter the peak wavelength of the emissions. The graph in Fig. 2 shows the radiation profiles of various objects and conditions. As an object's temperature increases, the location of the “peak” wavelength moves toward shorter wavelengths. The surface of the sun, at 6000 K, has its peak in the yellow region of the visible portion of the spectrum, and therefore, appears yellow in the sky. A fighter aircraft exhaust, at approximately 800 K, isn't hot enough to emit radiation in the visible spectrum. The fighter aircraft exhaust's peak emission occurs at

roughly three micrometers (mm) and is located in the infrared region of the spectrum.

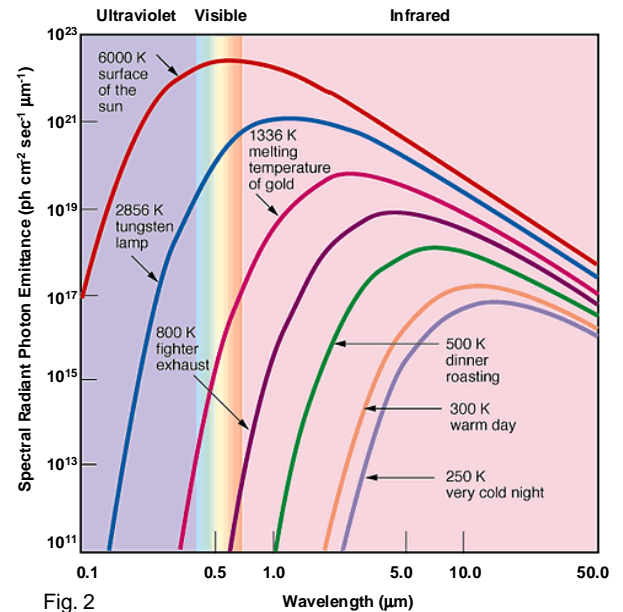


Fig. 2

Similar to the colors of the rainbow, the infrared spectrum is divided into subregions primarily based on how they are utilized in sensor systems. The boundaries of these regions are not absolute, but normal convention breaks down the infrared region into four basic categories: Short, Medium, Long and Very Long wavelength. Just beyond the color red in the visible spectrum, i.e. with a wavelength slightly longer than red, is an area known as Short Wavelength Infrared (SWIR). This band generally covers the wavelengths between 1-3 mm and is used by space based sensors to see the bright rocket plumes of boosting missiles. Slightly longer in wavelength and covering from 3- 8 mm is the area



Rockets in their “Boost” phase give off intense infrared radiation that is easily detected from space.